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# EXPERIMENTS FOR THE PRODUCTION OF NON-FERROUS METALS FROM CONVERTER DUST

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***Abstract.*** *The results presented show the production of lead from dusts generated during the purification of outgoing gas during the conversion process of a copper smelter. A technology has been developed to study the chemical composition of converter dust and determine its initial and physical properties during its processing. According to the proposed technology, zinc and copper are first transferred into solution by sulfuric acid leaching. From the remaining cake, the lead is first transferred to a brine solution and then the carbonation is precipitated as lead carbonate, which is calcined and melted in a reducing environment to produce metallic lead.*

***Keywords:*** *man-made waste, dust, leaching, pyrometallurgy, hydrometallurgy, sulfuric acid, salt, carbonation, separation, solution, sediment, technological scheme.*

# KONVERTER CHANGLARI TARKIBIDAGI RANGLI METALLARNI AJRATIB OLISH TAJRIBALARI

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***Annotatsiya.*** *Ushbu maqolada "OKMK"AJ mis eritish ishlab chiqarishni konvertatsiya qilish jarayonida chiqindi gazlarni tozalash jarayonida hosil bo'lgan changni o'rganish va o'rganish natijasida qo'rg'oshin ishlab chiqarish texnologiyasining parametrlari ko'rsatilgan. Konverter changining kimyoviy tarkibini o'rganib chiqib, uning kimyoviy va fizik xususiyatlariga asoslanib, uni qayta ishlash uchun oqilona texnologiya ishlab chiqilgan. Tavsiya etilgan texnologiyaga ko'ra, boshida sink va mis sulfat kislota eritmasi bilan eritmaga o'tkaziladi. Qolgan kekdan qo'rg'oshin avval tuz eritmasiga o'tkaziladi, so'ngra karbonatlash orqali qo'rg'oshin karbonat shaklida cho'kadi, u metal qo'rg'o –*

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*shin olinmaguncha qayta tiklash muhitida kalsinlanadi va eritiladi.*

***Kalit so'zlar:*** *texnogen chiqindilar, chang, yuvish, pirometallurgiya, gidrometallurgiya, sulfat kislota, tuz, karbonatlanish, ajratish, eritma, cho'kindi, texnologik sxema.*

# ЭКСПЕРИМЕНТЫ ДЛЯ ПОЛУЧЕНИЯ ЦВЕТНЫХ МЕТАЛЛОВ ИЗ КОНВЕРТЕРНОЙ ПЫЛИ

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***Аннотация.*** *В данной статье показаны параметры технологии получения свинца в результате изучения и исследования пыли, образующейся при очистке отходящих газов процесса конвертирования медеплавильного производства АО "АГМК". Изучив химический состав конвертерной пыли и основываясь на ее химические и физические свойства была разработана рациональная технология по ее переработке. Согласно предложенной технологии вначале цинк и медь переводят в раствор сернокислотным выщелачиванием. Из оставшегося кека свинец сначала переводят в солевой раствор, а затем карбонизацией осаждают в виде карбоната свинца, который прокаливается и плавится в востановительной среде до получения металлического свинца.*

***Ключевые слова:*** *техногенные отходы, пыль, выщелачивание, пирометаллургия, гидрометаллургия, серноя кислота, соль, карбонизация, разделение, раствор, осадок, технологическая схема.*

**Introduction.** There are numerous non-ferrous metallurgy wastes (dumps, slags, slimes, dust, clinker, etc.), which from an economic as well as environmental point of view, it is profitable and necessary to dispose of. This article provides an analysis of known methods and suggests new technological solutions for the autonomous processing of fine dust from the Almalyksky MMC copper smelter, which are man-made deposits of unique polymetallic raw materials, which are currently practically unused.

**Literature analysis and methods.** The relevance and novelty of the problem of recycling such waste lies in the steady growth of their volumes and the lack of effective recycling technology. The solutions proposed by the authors make it possible to selectively extract lead, copper and zinc from these raw materials and define the technology as environmental protection and diversification. Scientific and technological progress in the modern world is accompanied by a sharp increase in the consumption of natural resources and a simultaneous increase in the amount of industrial waste, the problem of rational use of which is closely related to the efficiency of industrial production, environmental

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protection and new developments in the field of waste disposal. The waste disposal technologies used in developed countries are 90-98% focused on their export to landfills and tailings dumps, incineration in recycling power plants or inefficient use at existing metallurgical enterprises, the main disadvantage of which are dust and gas emissions and associated losses of valuable elements, etc. In addition, landfills and tailings dumps require the allocation of significant land plots and violate the environmental situation in the surrounding areas. Uzbekistan has confidently embarked on the path of searching, developing, improving and implementing technologies for processing mineral and man-made secondary raw materials. Almalyk Mining and Metallurgical Combine is the pearl of the country [1], having convinced himself from his own experience that market relations call for initiative, reasonable risk, and the introduction of new developments, he chose for himself, among other things, one of the areas of activity – involvement in the processing of industrial waste (copper smelting dust, tailings of a copper concentrator, slag, clinker, etc.). Hundreds of thousands and tens of millions of tons of these and other wastes are generated and accumulated at the plant [2]. At copper smelting plants, one of the problems is the capture, purification and disposal of dust and gas emissions. The dust trapped in the electrofilters mainly contains metal sulfates, which disrupt the autogenicity of melting and contribute to lowering the temperature of the process, that is, they remove the problem with excess heat in the melting furnace. Therefore, dust is often used in circulation, wrapping them in a melting furnace. Meanwhile, plants for autonomous dust processing of copper smelting plants have been built and are successfully operating in the Russian Federation (Kirovograd), the USA (Wyoming), Japan, where the idea of using only part of the dust as recycled has been implemented, and the rest is processed autonomously and shows high technical and economic indicators. Table 1 shows the chemical composition of converter dust from domestic and some foreign copper smelters. There are still no practical recommendations for processing fine dust of electrofilters at the Almalyksky MMC copper smelting plant. This article

Table 1

| kompanent | Pb | Cu | Zn | Fe | $SiO_2$ | S | $S_{SO4}$ | MgO | CaO | Cd |
|---|---|---|---|---|---|---|---|---|---|---|
| % | 31,56 | 2,2 | 14,6 | 0,46 | 0,65 | 11,47 | 8,52 | 0,33 | 2,84 | 0,19 |

Table 2

***Results of sulfuric acid leaching of converter dust***

| $T, C^0$ | Степен растворения Cu и Zn , % | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Т:Ж =1:3 | | Т:Ж=1:4 | | Т:Ж=1:5 | | Т:Ж=1:6 | | Т:Ж=1:7 | | Т:Ж=1:8 | |
| | Cu | Zn | Cu | Zn | Cu | Zn | Cu | Zn | Cu | Zn | Cu | Zn |
| 60 | 18 | 10 | 26 | 17 | 34 | 23 | 53 | 39 | 72 | 54 | 70 | 74 |
| 70 | 32 | 20 | 45 | 35 | 55 | 48 | 75 | 59 | 84 | 70 | 80 | 76 |
| 80 | 44 | 30 | 56 | 46 | 76 | 60 | 85 | 74 | 95 | 86 | 92 | 88 |
| 90 | 45 | 40 | 58 | 52 | 77 | 63 | 84 | 75 | 94 | 84 | 90 | 88 |

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shows the possibility of effective autonomous complex processing of fine dust from the Almalyksky MMC copper smelter as a resource-saving and environmental protection measure. The purpose of the research work was to create fundamentally new, more economical technologies for processing converter dust to produce metallic lead with simultaneous extraction of copper and zinc concentrates, in relation to the current technological processes for producing copper and zinc with improved technological production modes. For the research, fine converter dust with an average content of the components listed in Table 1 and an industrial content of noble metals were used. The forms to be opened were CuO (gray tenorite), $Cu_2O$ (red cuprite), $CuSO_4$ (white anhydrous or blue chalcocyanite with a yellow tinge), etc. ($ZnSO_4$, $FeSO_4$, $PbSO_4$). Table 1 Results of chemical analysis of converter dust.

Mineralogical and X-ray phase analyses show the peculiarity of the dust, which consists in the content of significant amounts of sulfate forms of non-ferrous metals in them: in the initial dust, copper is 74 % sulfate, 14 % sulfide (mainly in the form of covellin) and 12 % oxide-silicate; iron is 70-72 % in the form of magnetite and 28-30 % sulfate 2-valent iron; lead and zinc are 80% in sulfate form [3]. As can be seen from the chemical and mineralogical composition, the dust of the converter's electrofilters is unique: it is rich in valuable components, mainly lead, zinc, copper, etc.

In addition, it is water-soluble, i.e. suitable for autonomous hydrometallurgical processing. As part of this study, a new technological scheme has been developed to obtain purified lead carbonate from fine converter dust, acceptable for the production of metallic lead without additional refining. The essence of the technological process is acid leaching, two-stage salt leaching of dust, carbonation from a salt solution of lead carbonate, calcination and reducing melting of lead carbonate to produce metallic lead [4]. To isolate copper, zinc and iron into the solution, sulfuric acid leaching of converter dust was carried out with the addition of an oxidizer (manganese concentrate), with a sulfuric acid content of 80÷120 g/l in the pulp at a temperature of 60-90 °C for 2 hours, T:W=1:3÷8 according to the developed technological scheme (Fig. 1). The results of sulfuric acid leaching are shown in Table 2. When leaching dust with sulfuric acid, the following reactions occur:

– conversion of lead oxides into sulfate precipitate:

$$PbO + H_2SO_4 \rightarrow PbSO_4 + H_2O,$$

– transfer of zinc and copper into solution:

$$ZnO + H_2SO_4 \rightarrow ZnSO_4 + H_2O,$$

$$CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O.$$

**Analysis and results.** As a result of leaching, at a given ratio T:W=1:3÷8, sulfuric acid is neutralized from an initial concentration of 80÷120 g/l to a pH value of 0.8-1 (30-35 g/l). Leaching was carried out at sulfuric acid concentrations of 40, 60, 80, 100, 120 and 140 g/l. According to the data obtained, the optimal concentration of sulfuric acid is for the complete transition of copper and zinc into a solution of 110-125 g/l (Fig. 2).

From the data obtained, it can be seen that during sulfuric acid leaching in more dilute pulps, an increase in temperature has a positive effect on the degree of dissolution of copper and zinc into solution and does not contribute to the dissolution of lead. High extraction of copper and zinc into the

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solution during acidic leaching of dust with complete separation of lead from impurities of copper, zinc and iron was achieved in the presence of the oxidizer manganese oxide. The effect is achieved by implementing a process whose chemical essence is due to the oxidation reaction of sulfide sulfur to elemental sulfur with the release of copper to a water-soluble form due to redox processes involving oxygen [5]. After filtration, the precipitate was washed with water to pH = 5.5 ÷ 6,0 at a water temperature of 80 °C. The resulting solution with a copper content of 5 g/l and zinc content of 22,5 g/l is a productive solution for the extraction of zinc and copper.

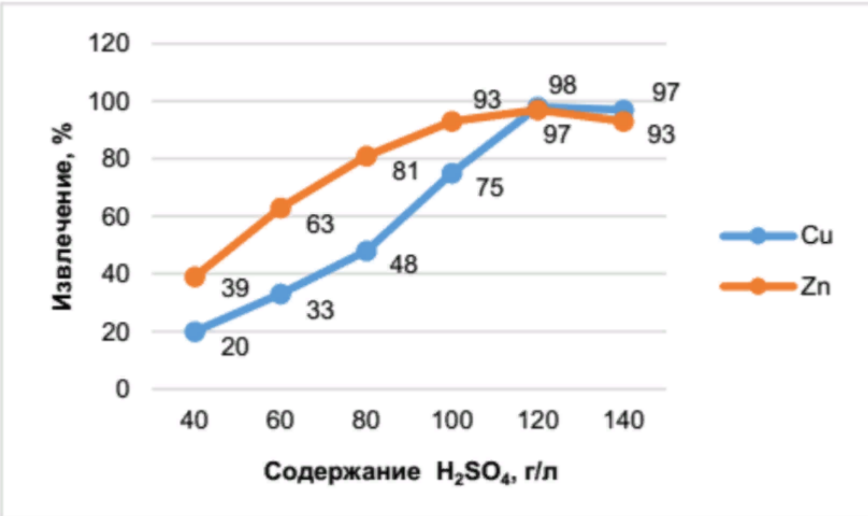


***Fig. 2. Dependence of the extraction of copper and zinc into solution on the concentration of sulfuric acid at a process duration of 2 hours***

To extract lead from the cake, two-stage salt leaching was carried out at a concentration of sodium chloride of 250 and 150 g/l, respectively, at a process temperature of 80-90 °C. The duration of leaching is 2 hours at each stage with a ratio of T:W=1:5. To purify lead chloride from undissolved components, the pulp was filtered [6].

**Conclusions.** As a result of technological and experimental studies, optimal technological parameters of the leaching process have been determined. Lead carbonation was carried out with the addition of soda ash to a pH of 8.5-9. $PbCl_2+Na_2CO_3=2PbCO_3+2NaCl$. After carbonation, the pulp was filtered out and the solution was used as a circulating solution. The resulting $PbCO_3$ cake was calcined at a temperature of 450 °C and obtained glet (PbO). The glass with the addition of flux and graphite was subjected to reducing melting and obtained metallic lead with a lead content of 99.06 % [7]. The analysis of the experiments allows us to draw the following conclusions: - during salt leaching of the cake in the temperature range from 60 to 80 °C, the ratio T:W=1:6 and the duration of the process from 2 to 4 hours, quartz and precious metals are not extracted into the solution;

- an increase in temperature has a positive effect on the degree of dissolution of lead during salt leaching;

- based on scientific research, a technology for processing converter dust has

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been developed, which allows to increase the yield of metallic lead with high extraction and the best technical, economic and technological indicators.

Thus, the conducted studies have shown the fundamental possibility of processing converter dust to produce metallic lead of at least 99 %.

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